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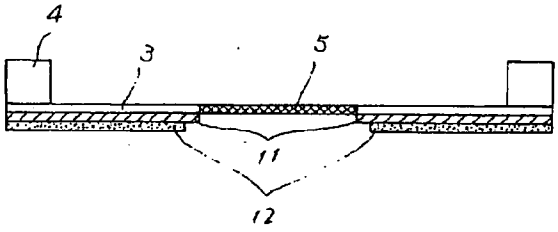
(54)【発明の名称】　スクリーン印刷版およびその製造方法

(57)【要約】

【目的】　各種電子部品の製造でパターン形成技術として広く用いられているスクリーン印刷において、印刷塗膜のエッジ部の盛り上がりを解消し、印刷塗膜の表面精度を向上させることを目的とする。

【構成】　スクリーンに形成する乳剤層を第１の乳剤層１１と第２の乳剤層１２の２層構造とし、かつ第１の乳剤層１１の開孔面積を所望の印刷形状より小さく設計し、第２の乳剤層１２の開孔面積を所望の印刷形状とすることにより、印刷塗膜のエッジ部の盛り上がりが抑制され塗膜厚みの均一性に優れたスクリーン印刷が実現できる。



3 --- スクリーン
4 --- 版枠
5 --- 開孔部
11 --- 第1の乳剤層
12 --- 第2の乳剤層

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【特許請求の範囲】

【請求項１】　スクリーンに所望の印刷形状からなる開孔部を有する乳剤層が形成されたスクリーン印刷版であって、上記開孔部の面積が被印刷物の当たる側とスクリーン側とで異なり、かつ被印刷物の当たる側の開孔面積を所望の印刷形状と同等とし、他方のスクリーン側の開孔面積を所望の印刷形状より小さくしたスクリーン印刷版。

【請求項２】　乳剤層は２層以上の多層構造からなる請求項１記載のスクリーン印刷版。

【請求項３】　感光乳剤が塗布されたスクリーン版に所望の印刷形状に比べ予め小さく設計したマスクを用いて写真製版法によって第１の乳剤層を形成する工程と、第１の乳剤層の上に再び上記感光乳剤を全面に塗布した後、所望の印刷形状のマスクを用いて写真製版法によって第１の乳剤層の上に第２の乳剤層を形成する工程とを具備するスクリーン印刷版の製造方法。

【請求項４】　支持体となるフィルム上に塗布された感光乳剤に所望の印刷形状に比べ予め小さく設計したマスクを用いて写真製版法によって第１の乳剤層を作製した後、第１の乳剤層をスクリーン版に密着させた状態で加圧することによってスクリーン版に転写する工程と、次に所望の印刷形状のマスクを用いて上記と同様にして第２の乳剤層を作製した後、上記と同様の方法で第２の乳剤層を第１の乳剤層の上に転写することで第２の乳剤層を形成する工程とを具備するスクリーン印刷版の製造方法。

【請求項５】　支持体となるフィルム上に塗布された感光乳剤をスクリーン版に密着させた状態で加圧することによってスクリーン版に転写した後、所望の印刷形状に比べ予め小さく設計したマスクを用いて写真製版法によって第１の乳剤層を形成るす工程と、次いで第１の乳剤層の上に再び上記感光乳剤を転写によって形成した後、所望の印刷形状のマスクを用いて写真製版法によって第１の乳剤層の上に第２の乳剤層を形成する工程とを具備するスクリーン印刷版の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、配線パターンの形成や印刷コンデンサなどの電子部品の製造に広く用いられているスクリーン印刷方法におけるスクリーン印刷版およびその製造方法に関する。

【０００２】

【従来の技術】スクリーン印刷方法は、所望のパターン形成の技術として最も広く知られ、実用されている技術の一つであり、特に電子部品業界においてはさまざまな分野で広く普及している。

【０００３】また、近年の電子部品の小型化、高精度化に伴い、比例的にスクリーン印刷による印刷塗膜に対する高精度化、高品質化への要求はますます高まっているのが実状である。

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【０００４】スクリーン印刷方法は、ステンレス、ナイロン、シルク等の微細なメッシュ状のスクリーンに形成された乳剤層に主に写真製版法によって所望の印刷形状からなる開孔部が製版された版を介してゴム製のスキージなどによって主に顔料、有機バインダおよび有機溶剤からなるペーストを上記開孔部から被印刷物上に押し出すことで所望形状の塗膜を形成するものである。

【０００５】ここで、従来のスクリーン印刷版は図５（ａ）に示すように、乳剤層１は基本的に単層であり、かつスクリーン３の開孔部５の面積は所望の印刷形状と同等に設計してあるのが一般的である。なお、図中の４は版枠を示す。

【０００６】

【発明が解決しようとする課題】しかしながら、上記のような構成では図５（ｂ）に示すように、乳剤層の開孔部のエッジ部に相当する印刷塗膜のエッジ部Ｅが中央部に比べて盛り上がるという問題があり、塗膜厚みに高い精度を要求される電子部品関連の印刷塗膜に関しては大きな課題となっている。そこで本発明は上記問題点に鑑み、印刷塗膜の乾燥後のエッジ部の盛り上がりを解消することが可能なスクリーン印刷版およびその製造方法を提供しようとするものである。

【０００７】

【課題を解決するための手段】上記目的を達成するために本発明は、スクリーン印刷版における乳剤層に形成された所望の印刷形状の開孔面積が被印刷物の当たる面とスクリーンに張られた面とで異なり、かつ被印刷物の当たる面の開孔面積を所望の印刷形状の開孔面積と同等とし、他方のスクリーンに張られた面の開孔面積を所望の印刷形状より小さくした構成を有するものである。

【０００８】

【作用】本発明は上記の構成によって、印刷ペーストが所望の印刷形状より小さくした開孔部を通過した後エッジ部に押し広がることで所望の印刷形状を形成することになる。このためエッジ部のペースト量を中央部に比べて局部的に少なくできるため、乾燥後においてもエッジ部分が中央部に比べて盛り上がったりすることのない均一な厚みの印刷塗膜を得ることが可能となる。

【０００９】

【実施例】

（実施例１）　以下、本発明の一実施例について図面を参照しながら説明する。図１は本発明の一実施例におけるスクリーン印刷版の断面を示す図である。ここで構成要素として１１は第１の乳剤層、１２は第２の乳剤層、３はスクリーン、４は版枠、５は製版された開孔部である。

【００１０】つぎにスクリーン印刷版について、その製造方法を説明する。まず、図２（ａ）の断面図に示すように、版枠４に枠張りしたメッシュ数２５０のステンレ

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ス製のスクリーン3の被印刷物の当たる面に市販のジアゾ系感光乳剤を乾燥後の厚みが約10μmになるように塗布し、第1の乳剤層21を形成した。つぎに、図2（b）に示すように、予め作製した所望の印刷形状に比べ予め寸法を小さく設計した長さ4．8mm、幅1．8mmの矩形の形状のマスク6Aを所定の位置に設定し（図は幅方向を概念的に示す）、通常の写真製版法で製版を行い、図2（c）に示すように上記第1の乳剤層1にマスク6Aの形状からなる開孔部を形成した。

【0011】こうして得られた第1の乳剤層21の上に図2（d）に示すように、上記と全く同様の感光乳剤を再び同じ厚みで塗布し、第2の乳剤層22を形成した。続いて所望の印刷形状である長さ5．0mm、幅2．0mmの矩形の形状のマスク6Bを用意し、図2（e）に示すように、マスク6Bを上記で形成した開孔部に対して各周辺部で均等寸法づつ（この場合、0．1mmになる）はみ出るように位置合わせを行い、上記と全く同様の方法で製版を行い、第2の乳剤層22にマスク6Bの形状からなる開孔部を形成した。このとき第1の乳剤層21の開孔部は2回目の製版の影響を受けることなく元の形状を保つため、結果的に図2（f）に示すように、乳剤層の開孔部のエッジ部が段差を有する第1および第2の乳剤層21，22からなる2層構造となり、スクリーン側の開孔部の面積が被印刷物の当たる側に比べて相対的に小さくなったスクリーン印刷版を作製することができた。

【0012】以上の実施例では2回の製版工程により乳剤層が2層構造の版を得たが、最終の製版工程でマスクの形状を所望の印刷形状とすれば同様の製版工程を繰り返すことで乳剤層が2層以上の多層構造とすることも可能である。

【0013】（実施例2）　以下本発明の第2の実施例について、第1の実施例における図1と全く同様な構成のスクリーン印刷版の製造方法を図面を参照しながら説明する。

【0014】まず、ゼラチン系感光乳剤が厚み約10μmで塗布された第1および第2の製版用既感光性フィルムを用意し、次に図3（a）（b）の断面図に示すように第1の実施例と全く同様のマスク6Aおよび6Bをそれぞれフィルム面に密着させて通常の写真製版法で製版を行い、第1のフィルム7Aにはマスク6Aからなる乳剤層31を、また第2のフィルム7Bにはマスク6Bからなる乳剤層32をそれぞれ形成した。

【0015】次に、図3（c）に示すように、まず上記で作製した第1のフィルム7Aの乳剤層31側を上にして所定の台の上に置き、第1の実施例と全く同様のスクリーン3を被印刷物の当たる面を下にしてこの上に乗せ、次にスクリーン3側からゴムローラ8で加圧し、続いて第1のフィルム7Aを剥離することで第1の乳剤層31をスクリーン3に転写した。

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【0016】次に、図3（d）に示すように、第1の実施例の場合と同様にして乳剤層32の開孔部が上記で形成した乳剤層31の開孔部に対して各周辺部で均等寸法づつはみ出るように第2のフィルム7Bとスクリーン3の位置合わせを行い、上記と全く同様の方法で乳剤層31の上に乳剤層32を形成した。こうして開孔部のエッジ部で段差を有する第1および第2の乳剤層からなる2層構造の乳剤層とすることで、スクリーン側の開孔部の面積が被印刷物の当たる側に比べて相対的に小さくなったスクリーン印刷版を作製した。

【0017】以上の実施例では2回の製版工程により乳剤層が2層構造の版を得たが、最終の製版工程で転写により形成する乳剤層の開孔部を所望の印刷形状とすれば同様の製版工程を繰り返すことで乳剤層が2層以上の多層構造とすることも可能である。

【0018】（実施例3）　以下本発明の第3の実施例について、第1の実施例における図1と全く同様な構成のスクリーン印刷版の製造方法を図面を参照しなから説明する。

【0019】まず、PVA系感光乳剤が厚み約10μmで塗布された第1の製版用既感光性フィルムを用意し、図4（a）に示すように、第1のフィルム7Cの乳剤層41側を上にして置き、第1の実施例と全く同様のスクリーン3を被印刷物の当たる面を下にしてこの上に乗せる。次にスクリーン3側からスプレー等で水を吹きつけ、ゴムローラ8で加圧し、十分に水分を乾燥させた後に第1のフィルム7Cを剥離することで第1の乳剤層41をスクリーン3に転写した。この状態で第1の実施例の図2（a）に示すところの乳剤層が形成されたスクリーン版と全く同等のものが得られたわけである。したがって、以降の作業はほぼ第1の実施例の方法に準じている。そこで、図4（b）に示すように第1の実施例と全く同様にして、マスク6Aを用いて第1の乳剤層41に通常の写真製版法で製版を行った。

【0020】次に、こうして得られた乳剤層41の上に、図4（c）に示すように、上記と全く同様の方法で同じ厚みの感光乳剤を転写し第2の乳剤層42を形成した。続いて第1の実施例と全く同様のマスク6Bを用いて第1の実施例と全く同様にして製版を行い、マスク6Bの形状からなる乳剤層42を形成した。このとき第1の乳剤層41の開孔部は2回目の製版の影響を受けることなく元の形状を保つため、図4（d）に示すように、第1および第2の実施例で作製した版と同等のスクリーン側の開孔部の面積が被印刷物の当たる側に比べて相対的に小さくなったスクリーン印刷版を作製することができた。

【0021】以上の実施例では2回の製版工程により乳剤層が2層構造の版を得たが、最終の製版工程でのマスクの形状を所望の印刷形状とすれば同様の製版工程を繰り返すことで乳剤層が2層以上の多層構造とすることも

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可能である。

【００２２】（実施例４）第１、第２および第３の実施例において、いずれも図１に示すように乳剤層が開孔部のエッジ部で段差を有する２層構造を成し、スクリーン側の開孔部の面積が被印刷物の当たる側に比べて相対的に小さくなったスクリーン印刷版を作製した。これらの版は構造的に同等であり、かつ印刷時の状態についても同等の効果が見込まれるため、本実施例では上記の実施例１で作製したスクリーン版のみを代表させて用い、実際の印刷実験を行った。

【００２３】まず、被印刷物として市販のポリエステル製フィルム、印刷用ペーストとして市販の銅ペーストを用意し、ゴム製スキージによる通常のスクリーン印刷方法により同一条件で５０回の印刷を行い、印刷塗膜を形成した。こうして得られた印刷塗膜の表面を接触式の表面粗さ計で幅方向に走査することで印刷塗膜の中央部およびエッジ部での平均厚みを求め、下記の式で定義したエッジ部の盛り上がり率（%）（以下、Ｒｅと記す）を算出した。

【００２４】Ｒｅ（%）＝（エッジ部膜厚－中央部膜厚）÷（中央部膜厚）×１００

また、比較のためマスク６Ｂを用いて通常の１回の写真製版方法で乳剤層の厚みが約２０μｍのスクリーン印刷版を作製し、これを用いて上記と全く同様の条件で印刷を行い、続いて上記と全く同様の方法で測定したＲｅを求めて従来例の標準データとした。以上の結果を下記の（表１）にまとめて示した。

【００２５】

【表１】

	Ｒｅ（%）
従来例	７４．５
本発明品	０．４

この（表１）より明らかなように、本実施例による乳剤層が開孔部のエッジ部で段差を有する２層構造を成しスクリーン側の開孔部の面積が被印刷物の当たる側に比べて相対的に小さくなった印刷版を用いてスクリーン印刷を行った印刷塗膜については、その塗膜の表面状態の改善に優れた効果が得られていることがわかる。

【００２６】以上のように本実施例によれば、スクリーン印刷において本発明による乳剤層に形成された開孔部

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の面積が被印刷物の当たる側とスクリーン側とで異なり、かつ被印刷物の当たる側の開孔面積を所望の印刷形状と同等とし、他方のスクリーン側の開孔面積を所望の印刷形状より小さくした版を用いることにより、印刷塗膜のエッジ部の盛り上がりを抑制することができ、中央部とエッジ部とにおける印刷塗膜の厚みの均一性を大幅に改善することが可能となる。

【００２７】なお、上記の実施例では、印刷用ペーストとして市販の銅ペーストを用い、矩形の形状の塗膜形成の場合について説明したが、本発明はあらゆる種類のペーストおよび印刷形状の場合にも適用できるものである。

【００２８】

【発明の効果】以上の実施例の説明より明らかなように、本発明はスクリーン印刷版における乳剤層に形成された開孔部の面積が被印刷物の当たる側とスクリーン側とで異なり、かつ被印刷物の当たる側の開孔面積を所望の印刷形状と同等とし、他方のスクリーン側の開孔面積を所望の印刷形状より小さくした版を構成し、そしてこれを用いることにより、印刷塗膜のエッジ部の盛り上がりを抑制することができ、中央部とエッジ部とにおける印刷塗膜の厚みの均一性を大幅に改善することができる優れたスクリーン印刷が可能となり、スクリーン印刷方法による印刷塗膜の形成に画期的な効果をもたらすものである。

【図面の簡単な説明】

【図１】本発明によるスクリーン印刷版の構成を示す断面図

【図２】本発明の第１の実施例における製版の工程図

【図３】本発明の第２の実施例における製版の工程図

【図４】本発明の第３の実施例における製版の工程図

【図５】（ａ）従来のスクリーン印刷版の構成を示す断面図

（ｂ）従来のスクリーン印刷版において印刷した塗膜の形状を説明する図

【符号の説明】

３　スクリーン

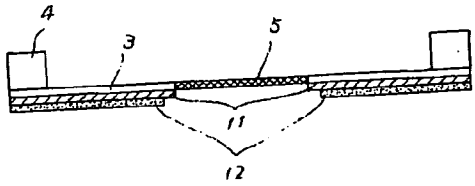
４　版枠

５　スクリーン版内の開孔部

１１　第１の乳剤層

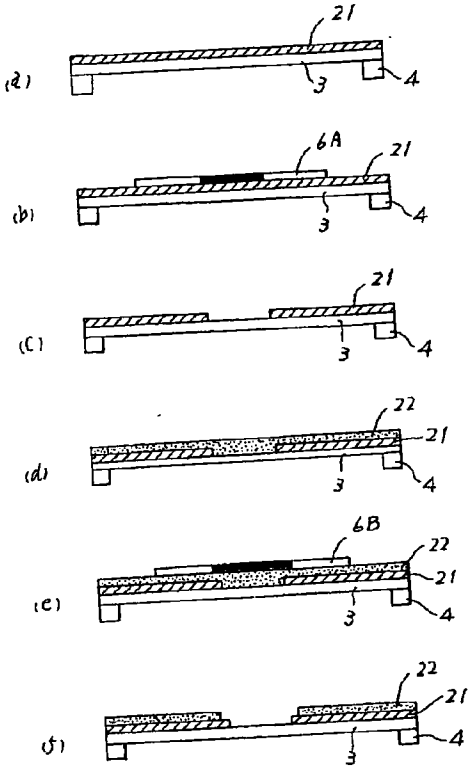
１２　第２の乳剤層

【図1】



3 --- スクリーン
4 --- 版枠
5 --- 開孔部
11 --- 第1の乳剤層
12 --- 第2の乳剤層

【図2】



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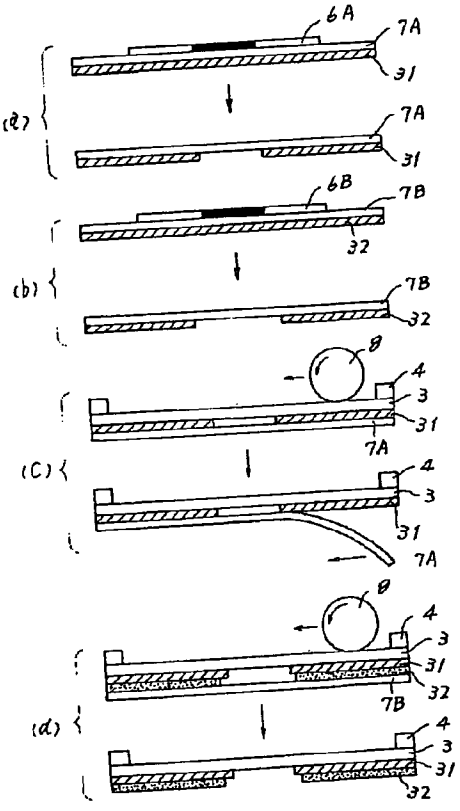

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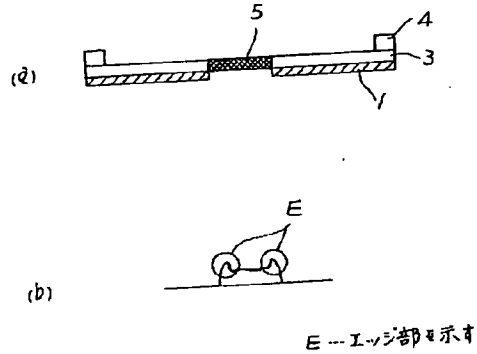
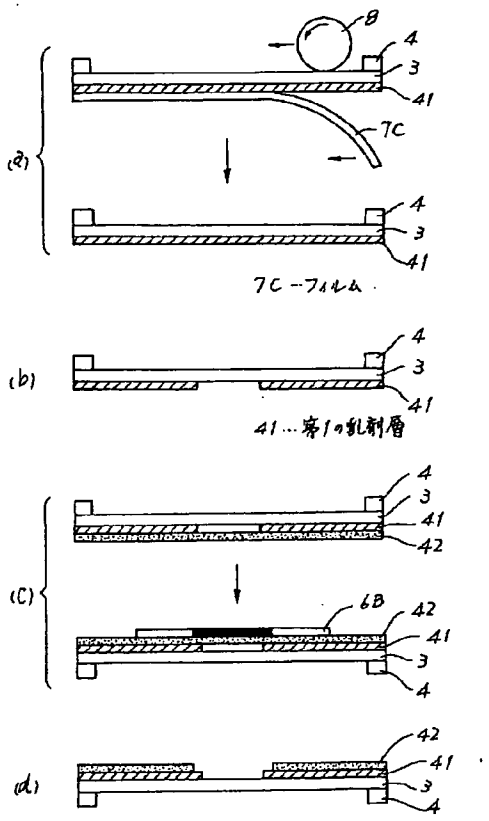


E --- エッジ部を示す

【図４】


8
4
3
41
7C
(a)
4
3
41
7C－フィルム
(b)
4
3
41
41…第1の乳剤層
4
3
41
42
(C)
6B
42
41
3
4
42
41
3
4
(d)

⑦

Japanese Patent Laid-open No. HEI 6-143855 A

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Applicant : Matsushita Denki Sangyo K.K.

Title : Screen printing plate and method for manufacturing same

(57) [Abstract]

[Object] To prevent lift at an edge portion of a print coated film to improve a surface accuracy of the print coated film in screen printing widely used in manufacture of various electronic parts as a pattern forming technique.

[Configuration] By forming an emulsion layer formed on a screen in a two-layered structure of a first emulsion layer 11 and a second emulsion layer 12, designing an opening area of the first emulsion layer 11 to be smaller than a desired printing shape, and setting an opening area of the second emulsion layer 12 to be equal to the desired printing shape, lift at an edge portion of a print coated film is suppressed so that a screen printing excellent in uniformity in coated film thickness can be realized.

[Scope of Claims for Patent]

[Clam 1] A screen printing plate where an emulsion layer with an opening portion formed in a desired printing shape is formed on a screen, wherein areas in the opening portion positioned on a side of contacting with a material to be printed and positioned on a side of the screen are different from each other, and the area of the opening portion positioned on the side of contacting with a material to be printed is made equal to the desired printing shape while the area of the opening portion positioned on the side of the screen is made smaller than the desired printing shape.

[Claim 2] The screen printing plate according to claim 1, wherein the emulsion layer has a multi-layer structure of two or more layers.

[Claim 3] A method for manufacturing a screen printing plate comprising the steps of: forming a first emulsion layer on a screen plate applied with photosensitive emulsion using a mask designed to be smaller than a desired printing shape in advance according to a photoengraving process; and after applying the same photosensitive emulsion as the photosensitive emulsion used in the above step on a whole surface of the first emulsion layer again, forming a second emulsion layer on the first emulsion layer using a mask with the desired printing shape according to the photoengraving process.

[Claim 4] A method for manufacturing a screen printing plate comprising the steps of: after producing a first emulsion layer on photosensitive emulsion applied on a film serving as a carrier using a mask designed to be smaller than a desired printing shape in advance according to photoengraving process, transferring the first emulsion layer on a screen plate by pressurizing the first emulsion layer in a closely contacting state with the screen plate; and after producing a second emulsion layer using a mask with a desired printing shape, forming a second emulsion layer by transferring the second emulsion layer on the first emulsion layer in the same process as the above.

[Claim 5] A method for manufacturing a screen printing plate comprising the steps of: after transferring photosensitive emulsion applied on a film serving as a carrier by pressurizing the photosensitive emulsion in a closely contacting state with a screen plate, forming a first emulsion layer using a mask designed to be smaller than a desired printing shape in advance according to a

photoengraving process; and after forming the same photosensitive emulsion as the photosensitive emulsion used in the above step on the first emulsion again, forming a second emulsion layer on the first emulsion layer using a mask with the desired printing shape according to the photoengraving process.

[Detailed Description of the Invention]

[0001]

[Industrial Applicability]

The present invention relates to a screen printing plate for a screen printing process method that is widely used for formation of a wiring pattern or manufacture of electronic parts such as a printing capacitor, and a method for manufacturing the same.

[0002]

[Conventional Art]

A screen printing method has been the most widely known as a technique for forming a desired pattern, it is one of techniques put in practical use, which is especially widespread in various fields in the electronic parts industry.

[0003] A demand for high precision and high quality on a print coating film obtained according to screen printing is actually increasing along with the miniaturization and high precision of the electronic parts.

[0004] The screen printing method is for forming a coating film with a desired shape by extruding, using a rubber squeeze or the like, paste principally including pigment, organic binder, and organic solvent on a material to be printed from an opening portion via a plate obtained by forming the opening portion with a desired printing shape in an emulsion layer formed on a fine mesh-like screen made

from stainless-steel, nylon, silk, or the like principally according to a photoengraving process.

[0005] As shown in Fig. 5(a), in a conventional screen printing plate, an emulsion layer 1 is basically a single layer and an area of an opening portion 5 of a screen 3 is generally designed to be equal to a desired printing shape. In Fig. 5(a), reference numeral 4 denotes a plate frame.

[0006]

[Problem to be solved by the Invention]

As shown in Fig. 5(b), in the above constitution, however, there is a problem that edge portions E of a print coated film corresponding to edge portions of the opening portion in the emulsion layer is lifted as compared with a central portion thereof, which results in serious problem as regards a print coated film associated with electronic parts required for high precision on thickness of the coated film. In view of the above problem, an object of the present invention is to provide a screen printing plate that allows solving the problem of the lift of edge portions after the print coated film is dried, and a method for manufacturing the same.

[0007]

[Means for solving the Problem]

In order to achieve the above object, the present invention is a screen printing plate where areas of an opening with a desired printing shape formed in an emulsion layer in a screen printing plate that are positioned on a side of a face contacting with a material to be printed and positioned on a side of a face where the screen is laid are different from each other, and the area of the opening positioned on the side of the face contacting with a material to be printed is made equal to the area of the opening corresponding to the desired printing shape while

the area of the opening positioned on the side of the face where the screen is laid is made smaller than the desired printing shape.

[0008]

[Operation]

According to the above constitution of the present invention, a desired printing shape is formed, because printing paste is extruded and spread out in the edge portion after it passes through the opening portion made smaller than the desired printing shape. Therefore, since an amount of paste at the edge portion can be locally reduced as compared with that at a central portion, it is possible to obtain a print coated film with an even thickness where the edge portion does not lift as compared with the central portion even after drying.

[0009]

[Embodiments]

(First Embodiment) One embodiment of the present invention is explained below with reference to the drawings. Fig. 1 is a sectional view of a screen printing plate in one embodiment of the present invention. As constituent elements, reference numeral 11 denotes a first emulsion layer, 12 denotes a second emulsion layer, 3 denotes a screen, 4 denotes a plate frame, and 5 denotes an opening portion plated.

[0010] A manufacturing method of the screen printing plate is explained. As shown in a sectional view in Fig. 2(a), commercially available diazo photosensitive emulsion was applied on a face of a screen 3 with a mesh number of 250 made from stainless-steel and laid to the plate frame 4 in a thickness of about 10 μm after drying, the face contacting with a material to be printed, so that a first emulsion layer 21 was formed. As shown in Fig. 2(b), a

mask 6A with a rectangular shape of a length of 4.8 mm and a width of 1.8 mm designed to be smaller in dimension than a desired printing shape, which was manufactured in advance, was set at a predetermined position (a widthwise direction is conceptually shown in Fig. 2(b)), and plate-making was performed according to a conventional photoengraving process, so that an opening portion having a shape of the mask 6A was formed in the first emulsion layer 1, as shown in Fig. 2(c).

[0011] As shown in Fig. 2(d), the same photosensitive emulsion as the above was applied on the first emulsion layer 21 obtained as described above in the same thickness as the above again, so that a second emulsion layer was formed. Subsequently, a mask 6B with a rectangular shape of a length of 5.0 mm and a width of 2.0 mm and with the desired printing shape prepared, the mask 6B was positioned such that respective sides thereof protruded beyond the opening portion formed in the above by equal sizes (0.1 mm in this case), as shown in Fig. 2(e), and a plate-making was performed utilizing completely the same process as the above, so that an opening portion with the shape of the mask 6B was formed on the second emulsion layer 22. At this time, since the opening portion in the first emulsion layer 21 maintained its original shape without being influenced by the second plate-making, a two-layered structure including the first and the second emulsion layers 21 and 22 where edge portions of the opening portion of the emulsion layers had stepped portions was eventually obtained, as shown in Fig. 2(f), so that a screen printing plate where an area of the opening portion on a side of the screen was smaller than an area thereof on a side of contacting with a material to be printed could be manufactured.

[0012] While in the embodiment, a plate where the emulsion layer had the two-layered structure is obtained by two plate-making steps, when the shape of the mask obtained in the final plate-making step is set to the desired printing shape, it is possible to obtain a multi-layered structure with two or more emulsion layers by repeating a similar plate-making step.

[0013]

(Second Embodiment) As regards a second embodiment of the present invention, a method for manufacturing a screen printing plate with the same constitution as that in Fig. 1 regarding the first embodiment is explained below with reference to the drawings.

[0014] First and second plate-making photosensitive films applied with gelatin photosensitive emulsion in a thickness of about 10 μm were prepared, plate-makings were performed in a state that masks 6A and 6B completely similar to the mask in the first embodiment were brought in close contact with film faces according to conventional photoengraving process, as shown in sectional views in Figs. 3(a) and 3(b), and an emulsion layer 31 formed of the mask 6A was formed on a first film 7A, while an emulsion layer 32 formed of the mask 6B was formed on a second film 7B.

[0015] As shown in Fig. 3(c), the first film 7A thus formed was placed on a predetermined stand such that the emulsion layer 31 faced upwardly, a screen 3 completely similar to that in the first embodiment was placed on the first film 7A such that a face thereof contacting with a material to be printed faces downwardly, the first film 7A was next pressurized from the side of the screen 3 using a rubber roller 8, and the first film 7A was then peeled off, so that the first emulsion layer 31 was transferred to the screen 3.

[0016] As shown in Fig. 3(d), the second film 7B and the screen 3 were aligned to each other such that respective peripheral sides of an opening portion of the emulsion layer 32 protruded beyond an opening portion of the emulsion layer 31 thus formed by equal dimensions like the first embodiment, and the emulsion layer 32 was formed on the emulsion layer 31 by exactly the same process as the above. By forming the emulsion layer having a two-layered structure including the first and second emulsion layers and having the stepped portion at the edge of the opening portion, a screen printing plate where the area of the opening on the screen side was relatively smaller than that of the opening on the side of contacting with a material to be printed was manufactured.

[0017] In the embodiment, a plate where the emulsion layer had the two-layered structure is obtained by two plate-making steps, but when the opening portion in the emulsion layer of the mask formed according to transfer in the final plate-making step is set to the desired printing shape, it is possible to obtain a multi-layered structure with two or more emulsion layers by repeating a similar plate-making step.

[0018]

(Third Embodiment) As regards a third embodiment of the present invention, a method for manufacturing a screen printing plate with the same constitution as that in Fig. 1 regarding the first embodiment is explained below with reference to the drawings.

[0019] A first plate-making photosensitive film applied with PVA photosensitive emulsion in a thickness of about 10 μm was prepared, a first film 7C was placed such that an emulsion layer 41 faced upwardly, as shown in Fig. 4(a), and a screen 3 exactly similar to that in the first

embodiment was put on the first film 7C such that a face thereof contacting with a material to be printed faced downwardly. After water was next sprayed from the screen 3 side using a spray or the like, pressurizing was performed using a rubber roller 8, and water content was sufficiently dried up, the first film 7C was peeled off, so that the first emulsion layer 41 was transferred to the screen 3. This state means that exactly the same screen plate as the screen plate formed with the emulsion layer shown in Fig. 2(a) for the first embodiment was obtained. Accordingly, works to be continued later were performed approximately according to the method in the first embodiment. As shown in Fig. 4(b), therefore, plate-making was performed on the first emulsion layer 41 using a mask 6A according to ordinary photoengraving process exactly similarly to the first embodiment.

[0020] As shown in Fig. 4(c), photosensitive emulsion with the same thickness was transferred to the emulsion layer 41 thus obtained in a method exactly similar to the above so that a second emulsion layer 42 was formed. Subsequently, plate-making was performed using a mask 6B exactly similar to that in the first embodiment exactly similarly to the first embodiment, so that the emulsion layer 42 with the shape of the mask 6B was formed. At this time, since the opening portion in the first emulsion layer 41 maintained its original shape without being influenced by the second plate-making, a screen printing plate where an area of an opening portion on the screen side was relatively smaller than that on the side of contacting with a material to be printed, which was similar to the printing plates formed according to the first and second embodiments, could be manufactured, as shown in Fig. 4(d).

[0021] In the embodiment, a plate where the emulsion layer had the two-layered structure is obtained by two plate-making steps, but when the shape of the mask obtained in the final plate-making step is set to the desired printing shape, it is possible to obtain a multi-layered structure with two or more emulsion layers by repeating a similar plate-making step.

[0022]

(Fourth Embodiment) In the first to fourth embodiments, all the screen printing plates where the emulsion layer had the two-layered structure having the stepped portion at the edge portion of the opening portion and the area of the opening portion on the screen side was relatively smaller than that on the side of contacting with a material to be printed were manufactured, as shown in Fig. 1. Since these plates are identical structurally and equivalent effects can be expected in their states at a printing time, only a screen plate manufactured according to the first embodiment was used as a representative example and actual printing experiment was performed in the fourth embodiment.

[0023] A Commercially available polyester film was prepared as a material to be printed and commercially available copper paste was prepared as a printing paste, and printing was performed fifty times according to an ordinary screen printing method under the same condition utilizing a rubber squeegee, so that print coated films were formed. By scanning surfaces of the print coated films thus obtained in their widthwise directions using a contact type surface roughness tester to obtain average thickness sizes of central portions and edge portions of the print coated films, lift ratios (%) (hereinafter, "Re") of the edge portions defined by the following equation were calculated.

[0024] Re(%)=(edge portion film thickness - central portion film thickness)÷(central portion film thickness)× 100

For comparison, a screen printing plate having an emulsion layer with a thickness of about 20 μm was manufactured using a mask 6B by a single ordinary photoengraving process and printing was performed under exactly the same condition as the above using the screen printing plate thus obtained. Subsequently, Re measured by the same method as the above was obtained and it was defined as standard data in the conventional example. The above results were collectively shown in the following Table 1.

[0025]

[Table 1]

	Re (%)
Conventional Example	74.5
Product of the present invention	0.4

As apparent from Table 1, regarding the print coated film obtained by performing screen printing using the printing plate where the emulsion layer according to this embodiment has the two-layered structure having the stepped portion at the edge portion of the opening portion and the area of the opening portion on the screen side is relatively smaller than that on the side of contacting with a material to be printed, it is found that excellent advantage is obtained for improvement in surface state of the coated film.

[0026] As described above, according to the embodiment, by using the plate according to the present invention where areas of an opening portion formed in an emulsion layer on a side of contacting with a material to be printed and on a

screen side are different from each other, and the area of the opening portion on the side of contacting with a material to be printed is set to be equal to a desired printing shape, while the area of the opening portion on the screen side is made smaller than the desired printing shape in screen printing, the lift of an edge portion of a print coated film can be suppressed, and it is made possible to improve evenness in thickness between a central portion and an edge portion of the print coating film remarkably.

[0027] While in the above embodiment, the case that a commercially available copper paste is used as the printing paste and a rectangular coated film is formed has been explained, the present invention can be applied to any kind of paste and any printing shape.

[0028]

[Effect of the Invention]

As apparent from the explanation of the above embodiments, by forming a screen printing plate where areas of an opening portion formed in an emulsion layer in a screen printing plate on a side of contacting with a material to be printed and on a screen side are different from each other, and the area of the opening portion on the side of contacting with a material to be printed is set to be equal to a desired printing shape, while the area of the opening portion on the screen side is made smaller than the desired printing shape and using the same, the present invention can perform excellent screen printing where the lift of an edge portion of a print coated film can be suppressed and evenness in thickness between a central portion and the edge portion of the print coated film can be remarkably improved, which provides significant

advantage for formation of a print coated film obtained by a screen printing method.

[Brief Description of Drawings]

[Fig. 1] A sectional view of a constitution of a screen printing plate according to the present invention.

[Fig. 2] A process diagram of plate making in a first embodiment of the present invention.

[Fig. 3] A process diagram of plate making in a second embodiment of the present invention.

[Fig. 4] A process diagram of plate making in a third embodiment of the present invention.

[Fig. 5] (a) A sectional view of a constitution of a conventional screen printing plate.

(b) A view for explaining a shape of a coated film printed using the conventional screen printing plate.

[Explanations of Letters or Numerals]

3 Screen

4 Plate frame

5 Opening portion in screen plate

11 First emulsion layer

12 Second emulsion layer

[Fig. 1]

3 Screen

4 Plate frame

5 Opening portion in a screen plate

11 First emulsion layer

12 Second emulsion layer

[Fig. 4]

7C Film

41 First emulsion layer

[Fig. 5]

E Represents edge portions